MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

4 MARCH 2020
9.00 A.M. – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 7 pages, including the cover page.
2. Answer all questions.
3. Write your answers in the Answer Booklet provided.
4. Show all relevant steps to obtain maximum marks.

QUESTION 1 (10 MARKS)

a) Figure Q1(a) below shows a photo frame hangs at a nail on a wall with a string. The photo frame is 0.9 kg heavy.

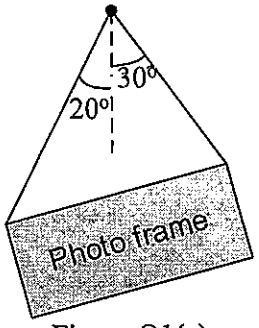

Figure Q1(a)

(i) Draw a free body diagram for the photo frame. State the forces and show their directions in your diagram. [3 marks]

(ii) Calculate each of the forces that acts on the photo frame. [5 marks]

b) Explain what static and kinetic frictions are. [2 marks]

QUESTION 2 (10 MARKS)

a) Using simple illustration, show how you measure period for mass-spring system and pendulum system. [2 marks]

b) A 0.50 *kg* object rests on a frictionless horizontal surface and is attached to the free end of the spring, which has a spring constant of $k = 300\ Nm^{-1}$. The object is pulled horizontally so that it stretches the spring 0.10 *m* and is released from rest at $t = 0\ s$.

(i) Determine the amplitude, A, of the motion. [1 mark]

(ii) Find angular frequency, ω, of the system. [1 mark]

(iii) What is the maximum speed achieved by the object once it is released from rest? [1 mark]

(iv) At which position does the object achieve its maximum speed as in (iii) ? [1 mark]

(v) Find maximum acceleration of the system. [1 mark]

(vi) Find total energy for this motion. [1 mark]

(vii) Write the equations of displacement and velocity describing the motion. [2 marks]

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QUESTION 3 (15 MARKS)

a) Categorize the following into transverse or longitudinal waves: sunlight, sound wave, wave on a slinky spring moved backwards and forwards, water wave. [2 marks]

b) State the principle of superposition. [1 mark]

c) Two waves are travelling on the same rope simultaneously. Their properties are listed in the table below.

Wave 1	Wave 2
Travels to the right.	Travels to the left.
Causes the rope to rise to a maximum height of 6 cm from the equilibrium position.	Causes the rope to fall to a maximum depth of 4 cm from the equilibrium position.
Wavelength is 15 cm.	Wave number is 0.5236 rad/cm.
Period is 0.4 s.	Frequency is 5 Hz.
Phase constant is 0 rad.	Phase constant is 0 rad.

(i) Write the equation for each wave using the sine function. [6½ marks]

(ii) Find the displacement of the rope for $x = 7$ cm at $t = 3$ s. [3 marks]

d) The power output of a whisper is 2 nW. Find the sound intensity level of the whisper 3 m away. [2½ marks]

QUESTION 4 (15 MARKS)

a) Define the following terms:
(i) law of reflection
(ii) refraction of light
(iii) total internal reflection
(iv) constructive interference of light [4 marks]

b) The prism is an equilateral triangle, and the ray is perpendicular to the axis of the rod, as shown in Figure Q4(b). The ray is refracted once as it enters the glass and then a second time as it exits to the air. What is the refracted angle of the ray, θ', once it come out from the prism, given that the index of refraction of the prism glass is 1.50?

[Hint: all angle must be measured with respect to line of normal]

[4 marks]

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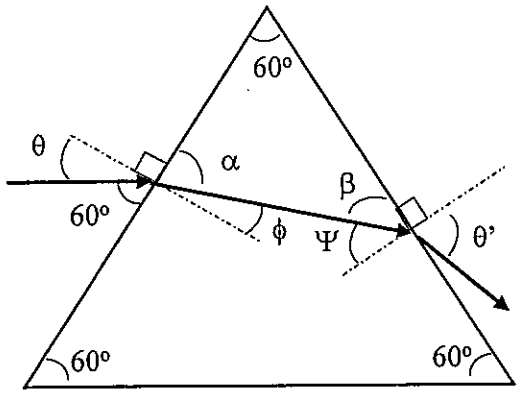

Figure Q4(b)

c) The third order bright fringe of 610 nm light is observed at an angle of 10° when the light falls on two narrow slits.
   (i) How far apart are the slits?
   (ii) If distance between slits and screen is 1.0 m, what shall the distance between second order bright fringe and fourth order bright fringe be? [3 marks]

d) White light shines on a diffraction grating with 3600 lines/cm. The diffracted light is observed on a screen 1.0 m away. Find the second-order positions for blue light (440 nm) and green light (560 nm). Sketch a view of the screen. [4 marks]

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APPENDIXES

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	9.11×10^{-31} kg
Proton mass,	m_p	=	1.67×10^{-27} kg
Neutron mass,	m_n	=	1.67×10^{-27} kg
Magnitude of the electron charge,	e	=	1.602×10^{-19} C
Universal gravitational constant,	G	=	6.67×10^{-11} N.m^2 kg^{-2}
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	1.38×10^{-23} J/K
Compton wavelength,	λ_c	=	2.426×10^{-12} m
Planck's constant,	h	=	6.63×10^{-34} J.s
		=	4.14×10^{-15} eV.s
Speed of light in vacuum,	c	=	3.0×10^8 m/s
Rydberg constant,	R_H	=	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	=	9.81 m s^{-2}
1unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	1.66×10^{-27} kg
1 electron volt,	1 eV	=	1.60×10^{-19} J
Avogadro's number,	N_A	=	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing,	I_o	=	1.0×10^{-12} W m^{-2}
Coulomb constant,	$k = \frac{1}{4\pi\varepsilon_o}$	=	9.0×10^9 Nm^2 C^{-2}
Permittivity of free space,	ε_o	=	8.85×10^{-12} C^2/N.m^{-2}
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ (T.m)/A
1 atmosphere pressure,	1 atm	=	1.0×10^5 N/m^2
			1.0×10^5 Pa
Earth: Mass,	M_E	=	5.97×10^{24} kg
Radius (mean),	R_E	=	6.38×10^3 km
Moon: Mass,	M_M	=	7.35×10^{22} kg
Radius (mean),	R_M	=	1.74×10^3 km
Sun: Mass,	M_S	=	1.99×10^{30} kg
Radius (mean),	R_S	=	6.96×10^5 km
Earth-Sun distance (mean),		=	149.6×10^6 km
Earth-Moon distance (mean),		=	384×10^3 km

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LIST OF FORMULA

Differential Rule

$y = kx^n$

$\frac{dy}{dx} = knx^{n-1}$

Trigonometric Identity

$\sin\theta = \frac{opposite}{hypotenuse}$ $\cos\theta = \frac{adjacent}{hypotenuse}$

$\tan\theta = \frac{opposite}{adjacent}$

$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$

$\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$

NEWTONIAN MECHANICS

$v = \frac{\Delta x}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $v = v_o + at$ $x - x_o = v_o t + \frac{1}{2}at^2$

$v^2 = v_o^2 + 2a(x - x_o)$ $x - x_o = \left(\frac{v_o + v}{2}\right)t$

$v = v_o + gt$ $y - y_o = v_o t + \frac{1}{2}gt^2$ $v^2 = v_o^2 + 2g(y - y_o)$ $y - y_o = \left(\frac{v_o + v}{2}\right)t$

$W = Fs\cos\theta$ $W = mg$ $\sum F = F_{net} = ma$ $f_s \le \mu_S F_N$

$f_k = \mu_K F_N$ $p = mv$ $\sum F = \frac{\Delta p}{\Delta t}$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ $m_1u_1 + m_2u_2 = (m_1 + m_2)\,v$

$K = \frac{1}{2}mv^2$ $PE_s = \frac{1}{2}kx^2$ $F_s = -kx$

$T_s = 2\pi\sqrt{\frac{m}{k}}$

Spring with mass, $\omega = \sqrt{\frac{k}{m}}$

Simple pendulum, $\omega = \sqrt{\frac{g}{l}}$ $T_p = 2\pi\sqrt{\frac{l}{g}}$ $T = \frac{2\pi}{\omega} = \frac{1}{f}$

Simple harmonic motion,

$x = A\cos(\omega t + \phi)$
$v = -\omega A\sin(\omega t + \phi)$
$a = -\omega^2 A\cos(\omega t + \phi)$

or

$x = A\sin(\omega t + \phi)$
$v = \omega A\cos(\omega t + \phi)$
$a = -\omega^2 A\sin(\omega t + \phi)$

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WAVES

$$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$$

$$y(x,t) = 2A\sin\ kx\ \cos\omega t$$

$$v = f\lambda \qquad \omega = 2\pi f$$

$$I = \frac{P}{A} \qquad \beta = 10\log_{10}\frac{I}{I_o}$$

$$f' = f\left(\frac{v \pm v_o}{v \mp v_s}\right) \qquad y(x,t) = A\sin(kx \pm \omega t + \phi)$$

OPTICS

$$n = \frac{c}{v} \qquad n_1\sin\theta_1 = n_2\sin\theta_2 \qquad \sin\theta_c = \frac{n_2}{n_1} \qquad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o} \qquad f = \frac{R}{2}$$

$$d\sin\theta_{max} = m\lambda \qquad a\sin\theta_{min} = m\lambda \qquad d\sin\theta_{min} = (m + \frac{1}{2})\lambda$$

$$y_{bright} = \frac{m\lambda L}{d} \qquad y_{dark} = (m + \frac{1}{2})\frac{\lambda L}{d}$$